Scintillator Calibration Using Tracked Muons

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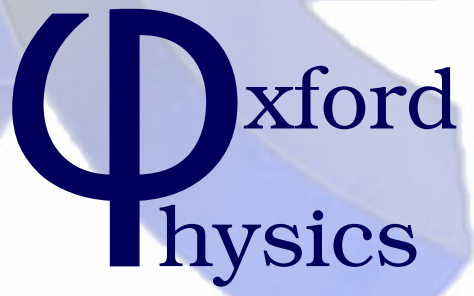
Calibration Phone Meeting

8th December 2005



Introduction

- Aiming to calibrate response of scintillator as function of time
- Using hits from tracked cosmic muons
- Looking at time dependence of 'average' response of detector to tracked muons
- Have plots for both near and far detectors

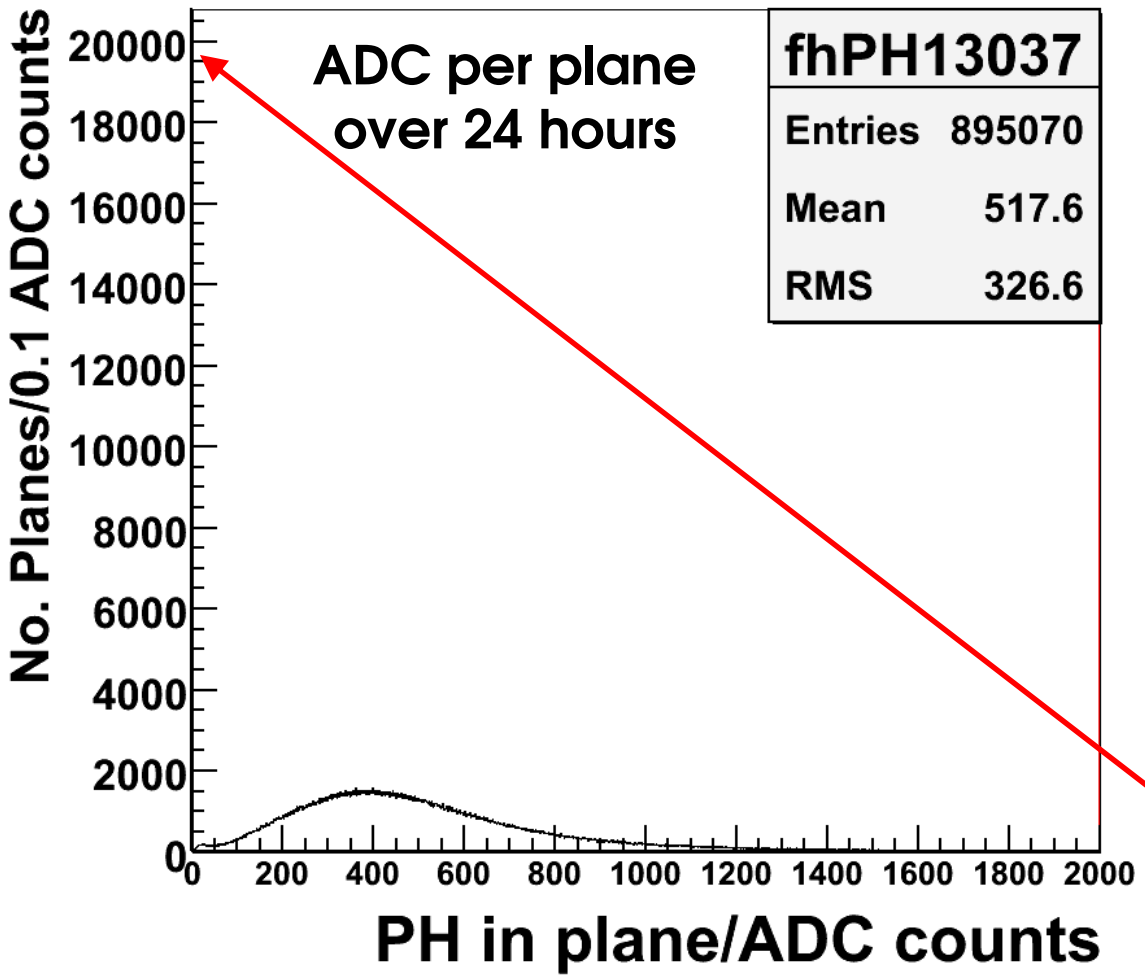
Method and Cuts

- Get all hits in NtpSRtrack object
- Sum all ADC in each plane
- Include gaps in tracks as 0-ph planes
- Cut out tracks that cross <9 planes
- Perform a path-length correction
- Cut out first and last planes in track
- Make fiducial cuts

Fiducial Cuts

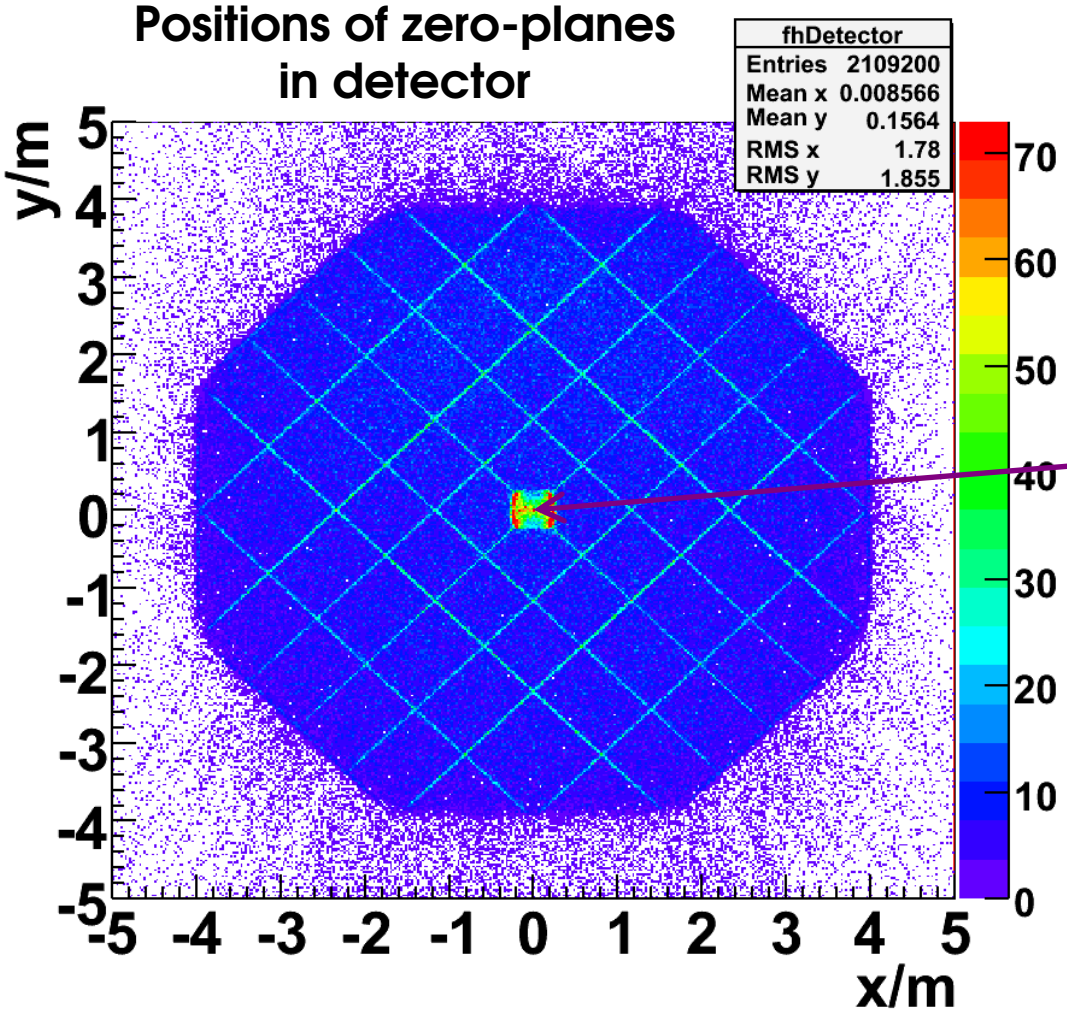
- Cut out planes where mean ADC <30cm from detector centre (coil hole)
- FD
  - Cut out planes where mean ADC position >3.5m from detector centre
- ND
  - Use planes where mean ADC position is within a circle, 1m radius, centred at (x,y)=(1,0)

Zero-Planes



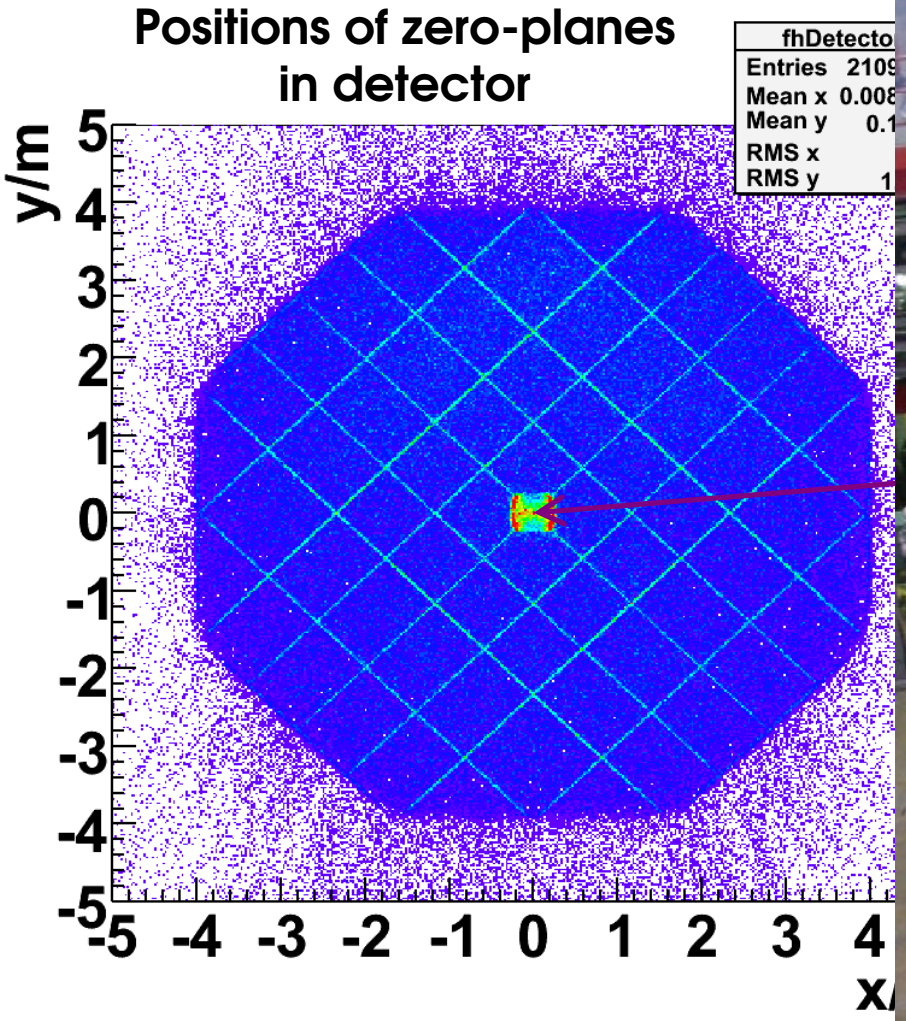
- Any gaps in tracks are counted as planes with zero ph
- Given a position by extrapolating between previous and next planes with deposited energy
- Height of zero-bin is ~20,000

Zero-Planes

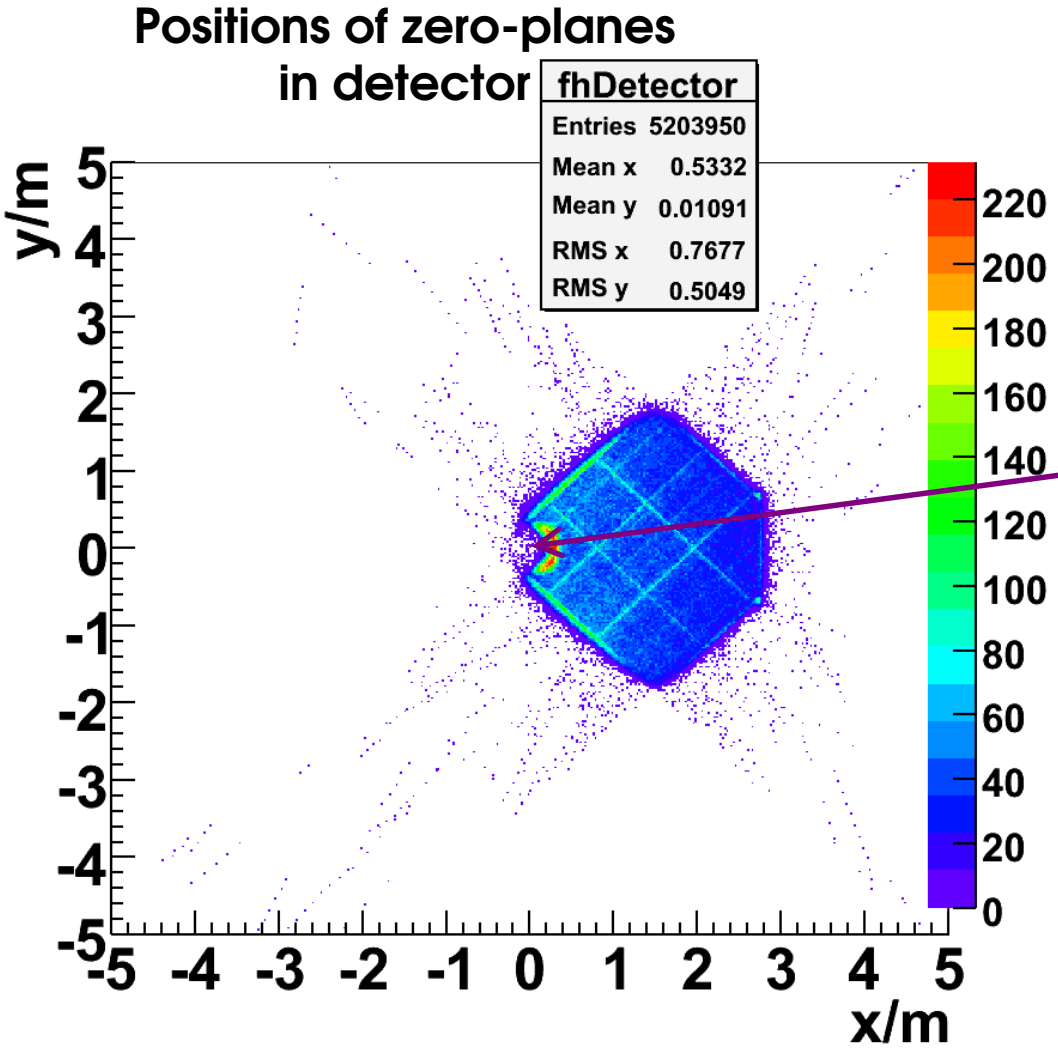


- Graph shows position of 0-ph planes in the far detector
- Cluster of zero-planes around coil-hole
- Central bin has ~160,000 hits
- Cut out hits near coil hole (<30cm from centre): shouldn't be time-dependent
- Scintillator module structure clearly visible

Zero-

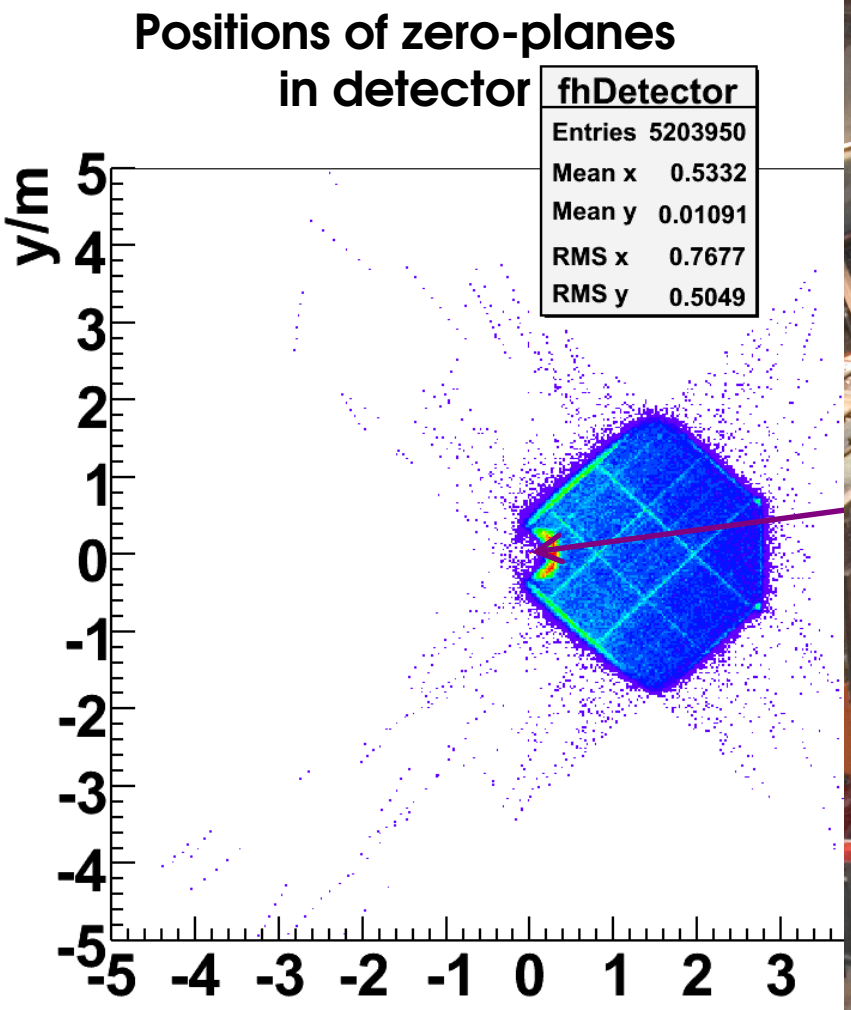

Positions of zero-planes
in detector
fhDetecto
Entries 2109
Mean x 0.008
Mean y 0.1
RMS x
RMS y 1
y/m
5
4
3
2
1
0
-1
-2
-3
-4
-5
-5 -4 -3 -2 -1 0 1 2 3 4

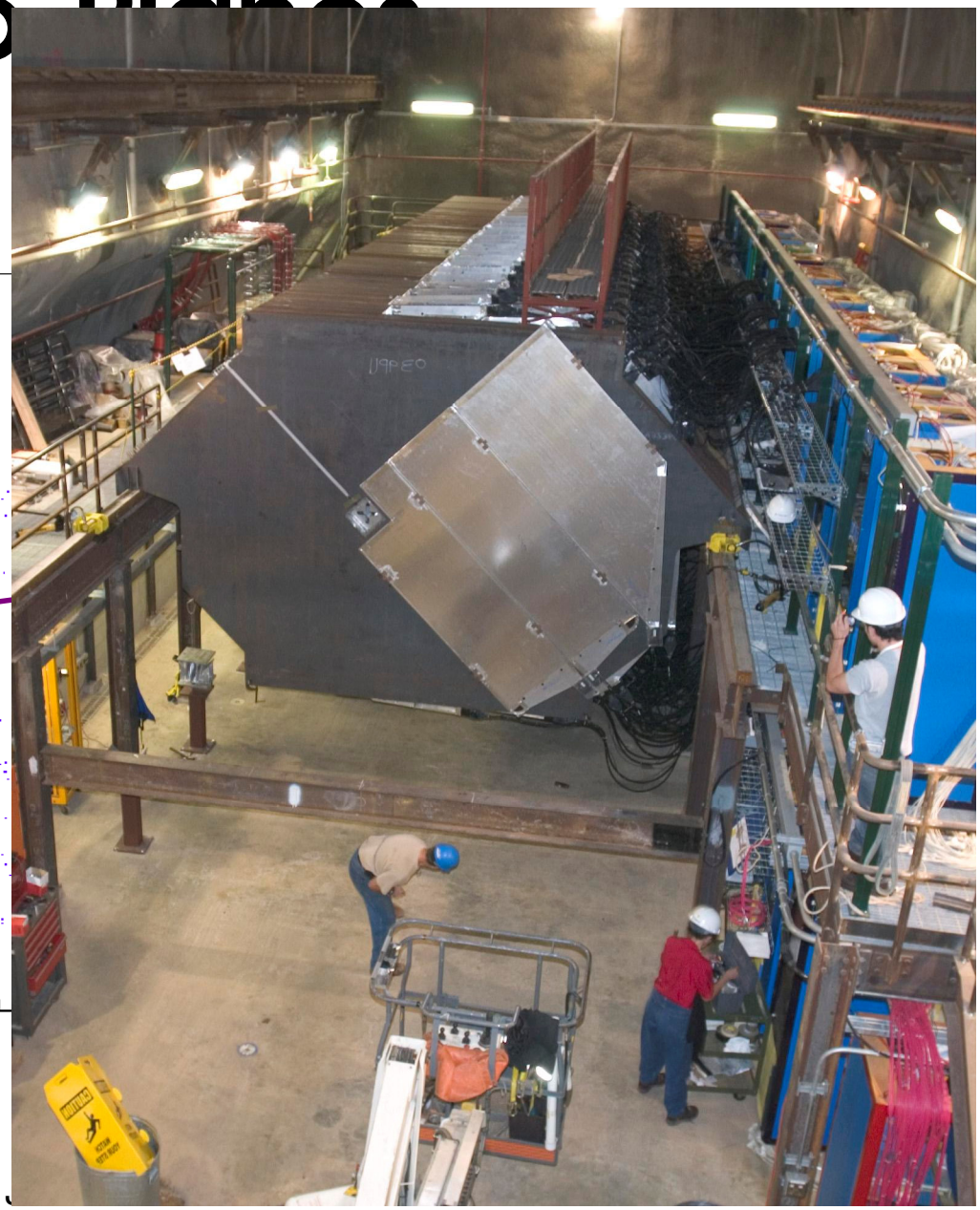
Zero-Planes



- Graph shows position of 0-ph planes in the far detector
- Cluster of zero-planes around coil-hole
- Central bin has ~600,000 hits
- Cut out hits near coil hole (<30cm from centre): shouldn't be time-dependent
- Scintillator module structure clearly visible

Zero Planes





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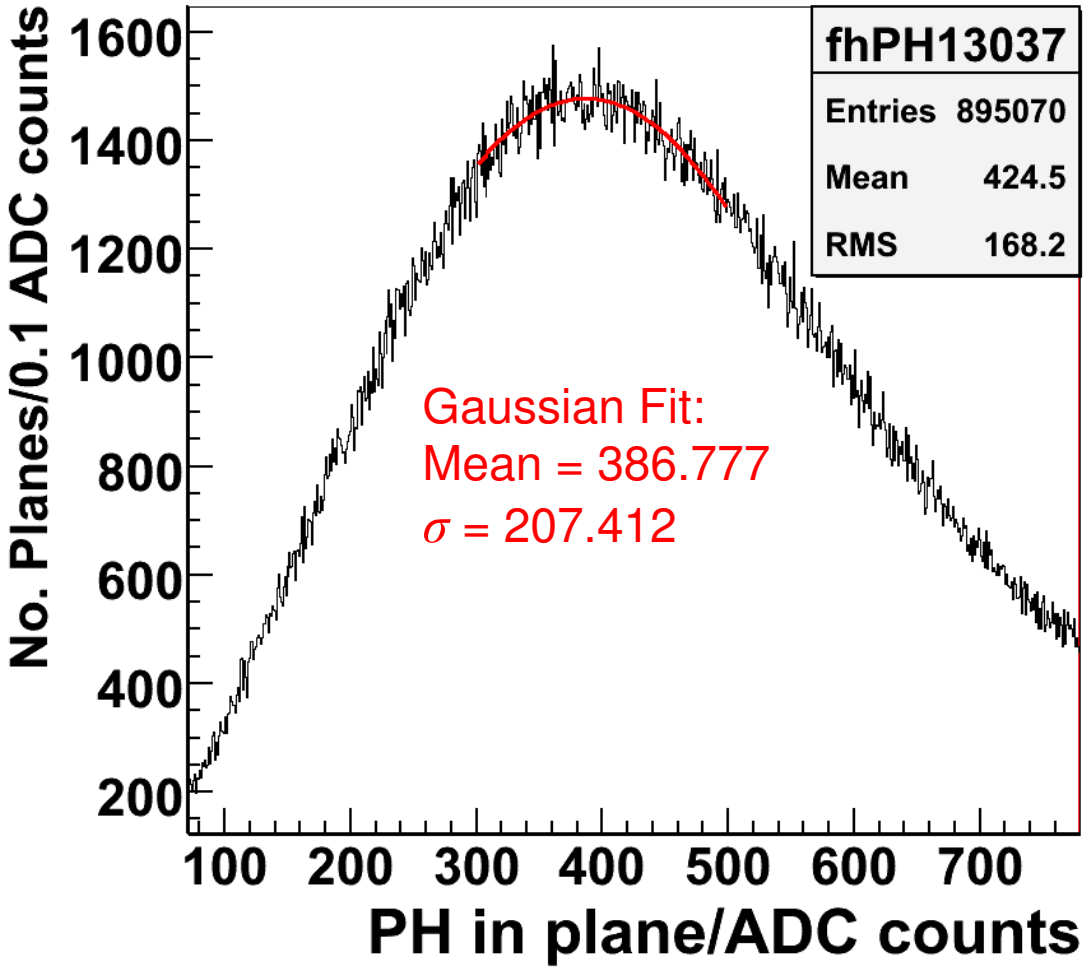
Calibration Figures

- Calculated the mean plane-summed ph with no truncation; using $\sigma/\sqrt{n}$ as error
- Calculated median with accuracy of 0.1 ADC; using $\sigma/\sqrt{n}$ of mean for error at the moment
- Calculated a Gaussian fit of the peak: plot central value; error is the Minuit error on the fit parameter

Gaussian Peak Fit

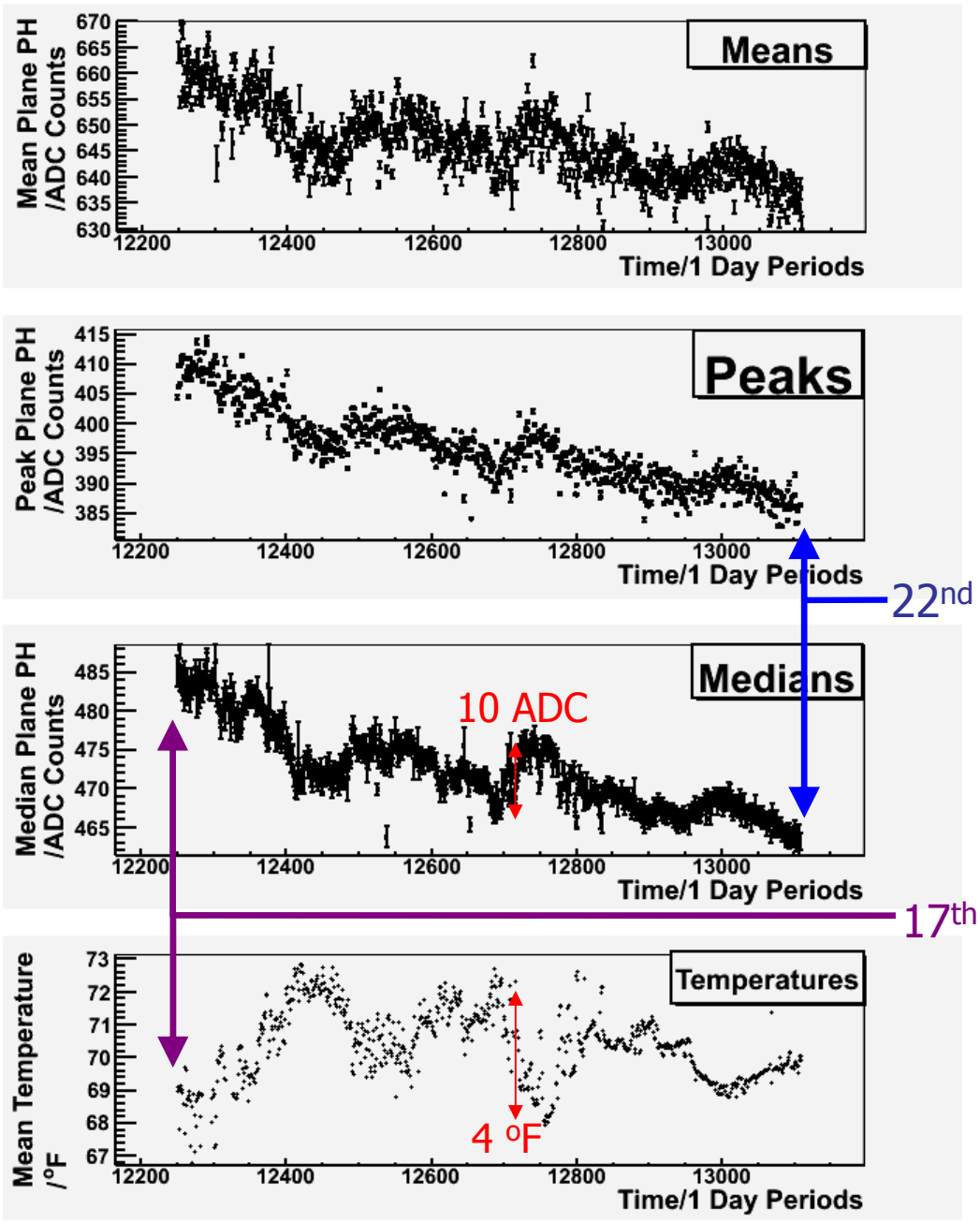


- Gaussian fitted between 300 and 500 ADC counts
- Small fitting range necessary as it's a Landau distribution, not Gaussian
- Peak not been seen to go outside this range yet: small fitting range should be safe

Results So Far

- Plotting FD figures in 1-day bins
- Plotting ND figures in 1-hour bins
- Canvasses show graphs of mean, peak & median plane-summed ph against time
- Also plot mean detector hall temperature against time

Far Detector

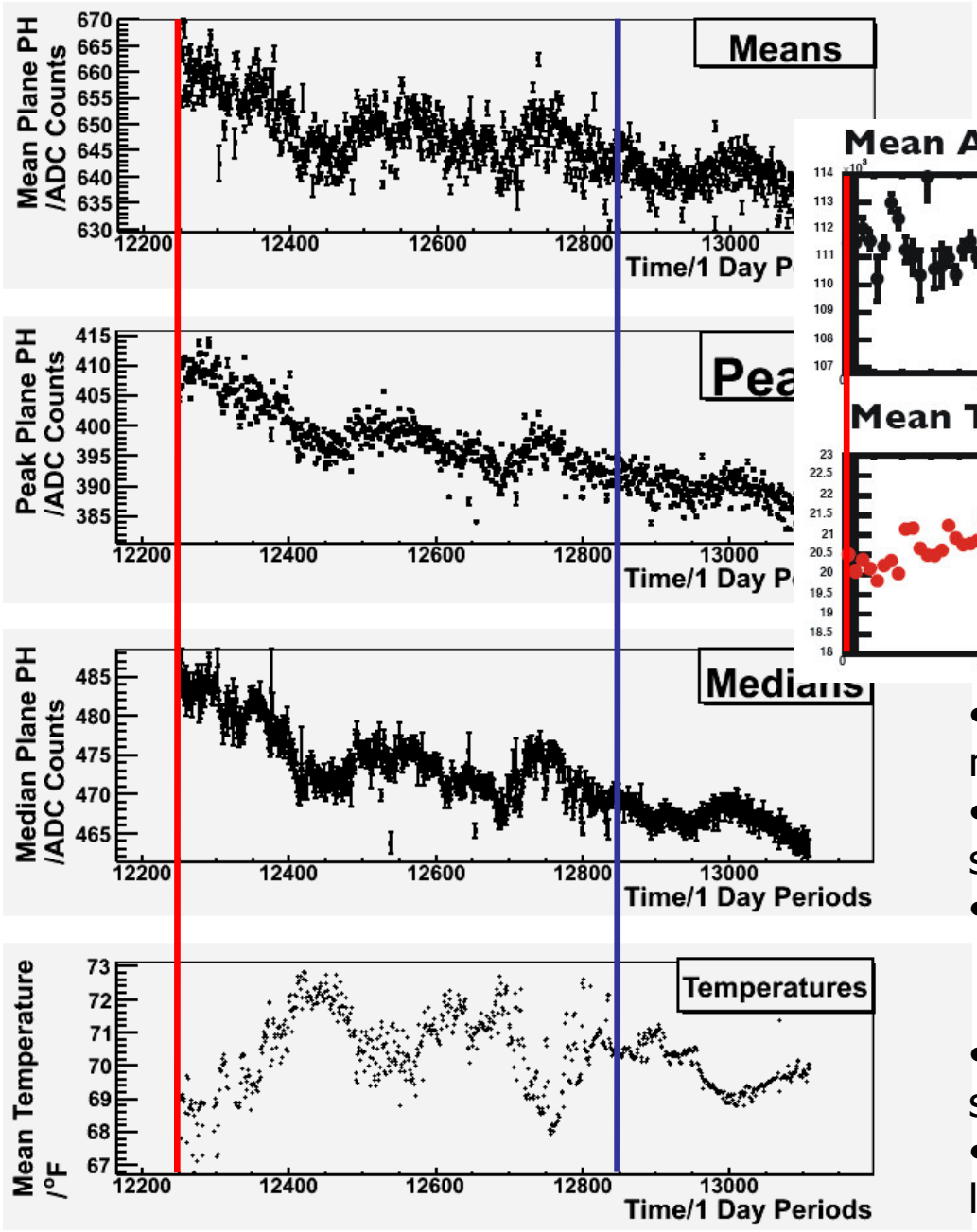


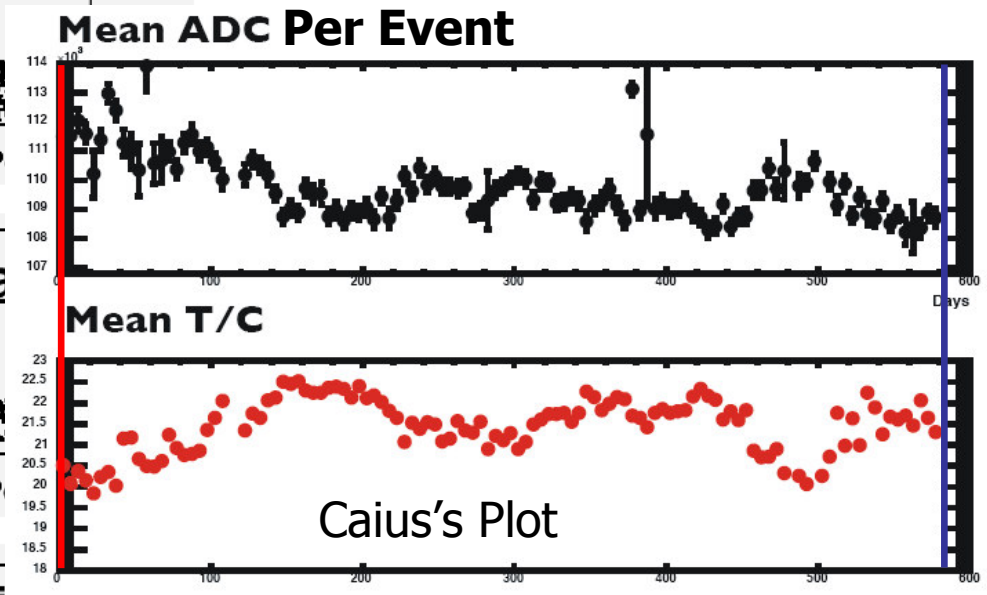
- Temperature and scintillator decay effects competing
- All three show ~25 ADC drop over ~850 days
- (Between 4.6% and 6.3% depending on which you look at)

- Inverse temperature dependence of scintillator response is evident

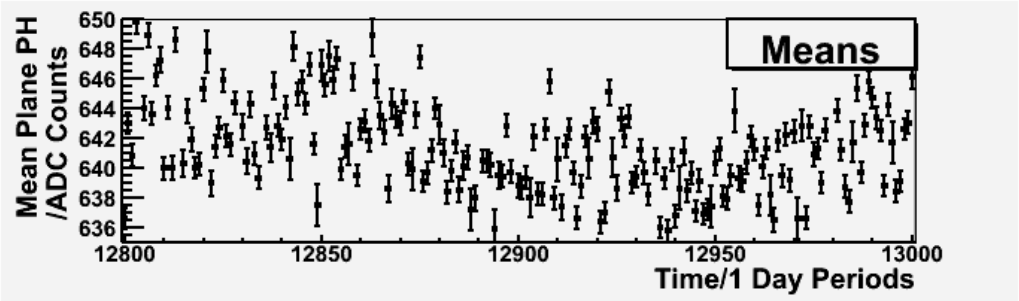
- Temperature change of ~2 °C ≡ median ph change of ~10 ADC (~2%)

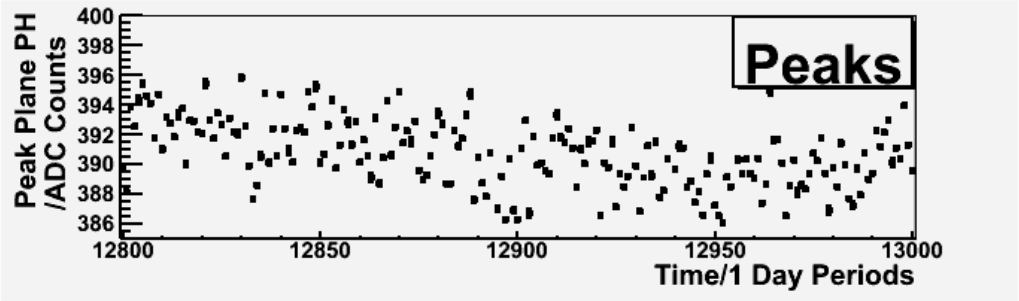
Far Detector

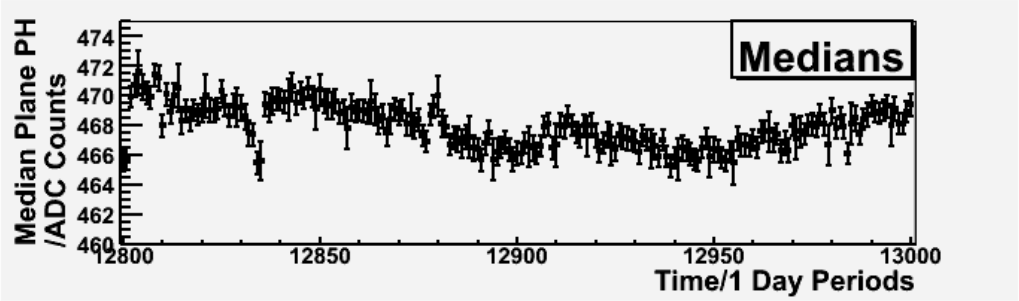


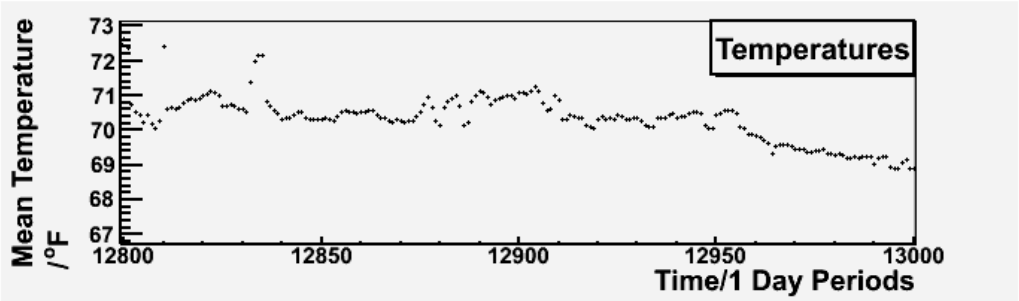


- Caius's plot from October collaboration meeting
- Temperature and scintillator decay effects still convoluted
- Caius:
  - 600 days ≡ ~3% drop
  - 1°C ≡ 1% ADC
- Temperature effects seem much the same as mine
- My scintillator decay possibly seems a little more pronounced



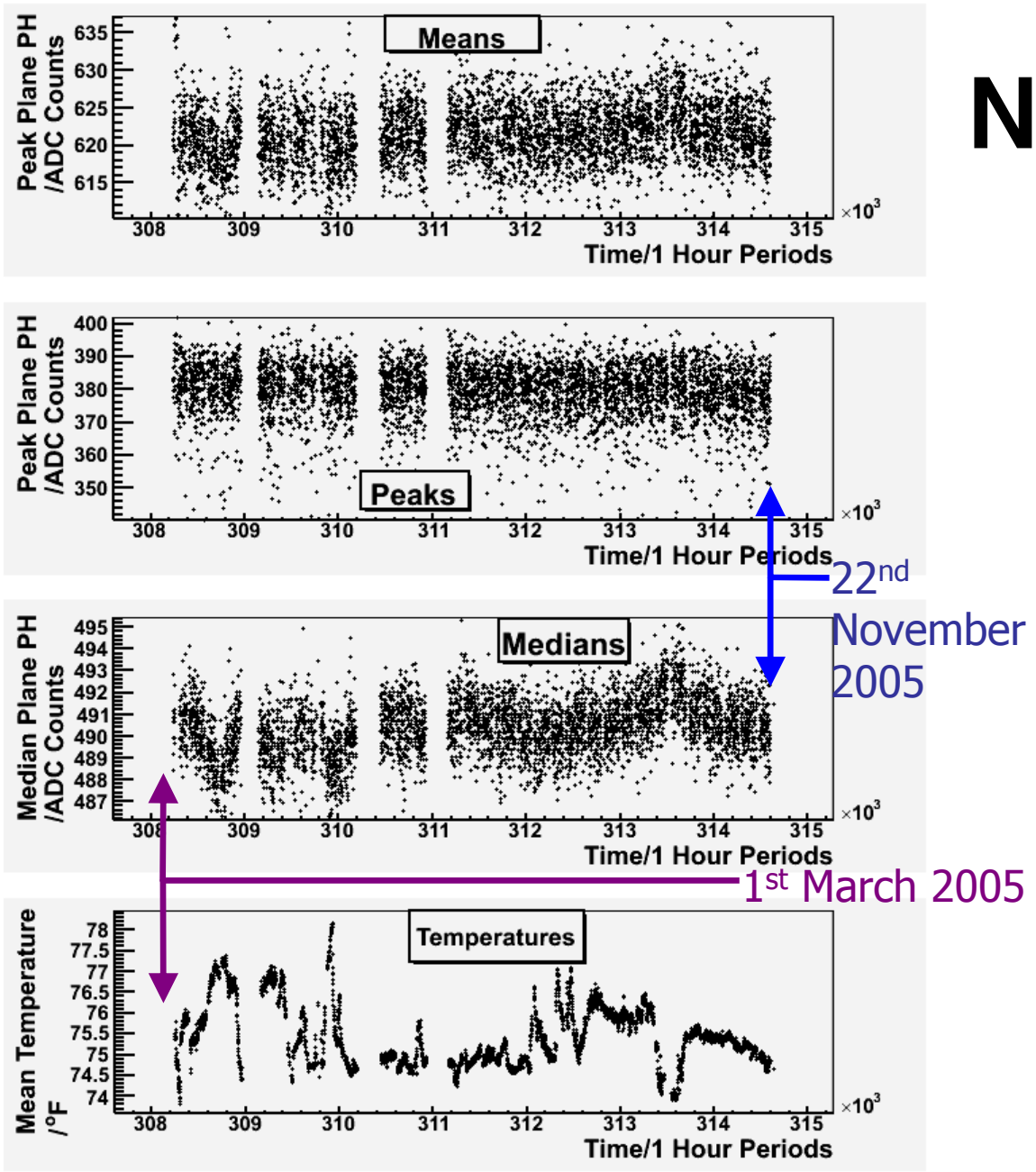






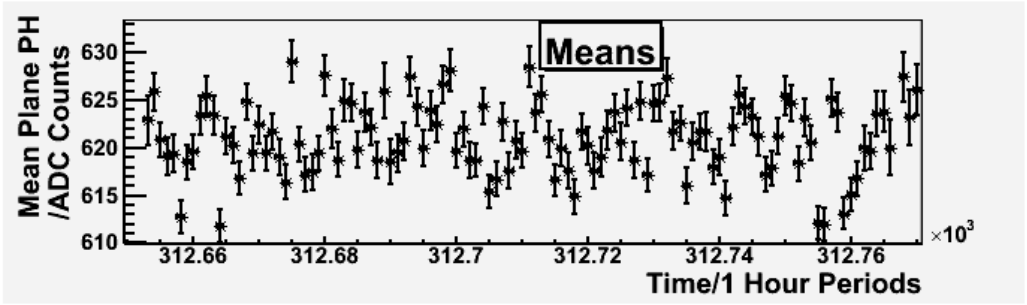
Stability

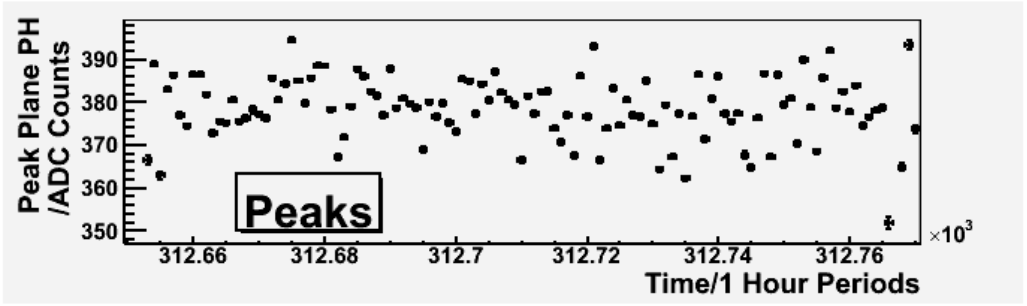
- Zoomed into a 200-day FD period
- y-axes all have 25 ADC range
- Median is the most stable measure
- Median consequently seems most sensitive to temperature variations

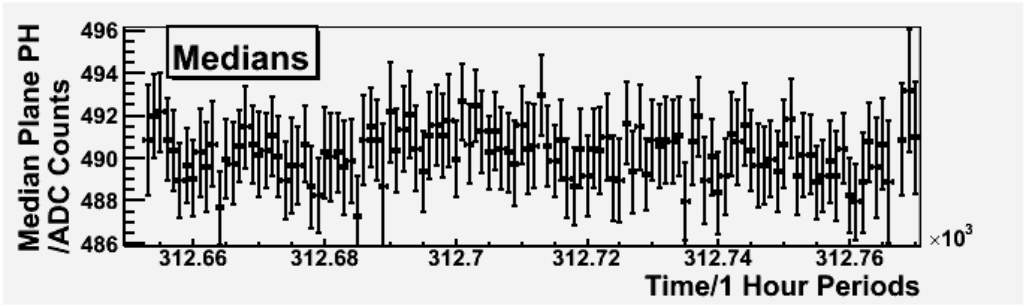


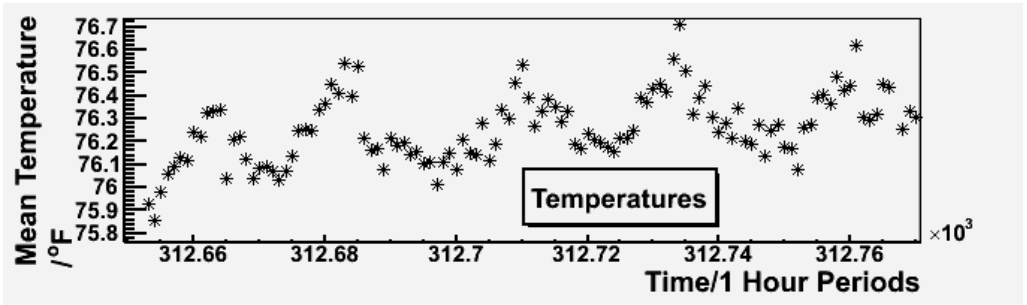
Near Detector

- 1 hour bin-length makes detail harder to see
- Error bars left off for clarity
- Temperature effects visible in medians
- No scintillator decay obvious in this time period









Near Detector

- Zoom into a 120-hour (5-day) period
- Median again the most stable and sensitive measure
- Temperature oscillations seem to have a 24-hour period
- With some imagination, median seems to follow temperature variations
  - Day-night effect?

Dead Planes

- If a region of the detector goes dead, this calibration should not correct for that
  - Remainder of detector should not be calibrated upwards to compensate
- Mean and median sensitive to dead planes, so would wrongly compensate
- However, 1 strip should be a negligible effect
- Peak fit is insensitive to dead planes
- Median is no longer the outright best figure

Conclusion

- Ready to start filling a database
- Decide how to deal with dead planes
- Put all the calibration figures in a database
  - Possibly use shorter time bins (1 hour for both detectors)
  - These can then be averaged as necessary when used